AD-A100 405 NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE PLYMOUTH DAM (NJ00818), DELAW--ETC(U)
MAY 81 R J MCDERMOTT, J E GRIBBON DACW61-79-C-0011
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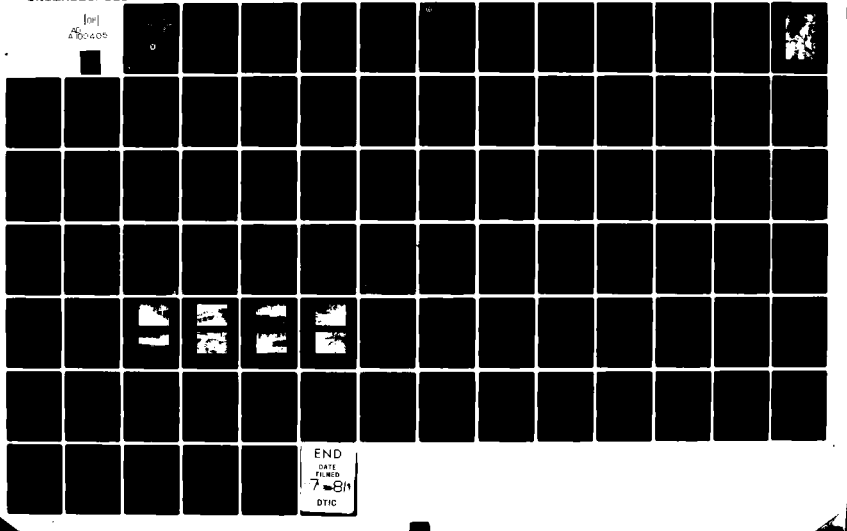

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DELAWARE RIVER BASIN,
TROUT BROOK, SUSSEX COUNTY
NEW JERSEY.

LEVEL II

LAKE PLYMOUTH DAM

NJ 00818

PHASE I INSPECTION REPORT.
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

MAY 1981

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REPT. NO.: PAEN/NAP-53842/NJ00818-81/05

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number): This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.	

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-N

11 JUN 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Plymouth Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Plymouth Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 36 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) The upstream face and crest of the dam should be properly protected against erosion.

(2) The spillway should be thoroughly renovated to provide adequate slope protection for the embankment.

(3) All trees and adverse vegetation on the embankment should be removed.

(4) Seepage at the dam should be periodically monitored by an engineer experienced in the design and construction of dams in order to assess any changes in its condition and its effects on the structural stability of the dam.

NAPEN-N
Honorable Brendan T. Byrne

c. The following remedial actions should be initiated within one year from the date of approval of this report:

(1) The ability to drain the lake should be investigated in the future by a professional engineer experienced in the design and construction of dams. If the need for a low level outlet is determined, a suitable outlet should be designed and installed.

(2) The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

d. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE PLYMOUTH DAM (NJ00818)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 30 December 1980 by Storch Engineers, under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Plymouth Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 30 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) The upstream face and crest of the dam should be properly protected against erosion.

(2) The spillway should be thoroughly renovated to provide adequate slope protection for the embankment.

(3) All trees and adverse vegetation on the embankment should be removed.

(4) Seepage at the dam should be periodically monitored by an engineer experienced in the design and construction of dams in order to assess any changes in its condition and its effects on the structural stability of the dam.

c. The following remedial actions should be initiated within one year from the date of approval of this report:

(1) The ability to drain the lake should be investigated in the future by a professional engineer experienced in the design and construction of dams. If the need for a low level outlet is determined, a suitable outlet should be designed and installed.

(2) The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

d. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

DATE: 9 JUN 1981

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Plymouth Dam, NJ00818
State Located:	New Jersey
County Located:	Sussex
Drainage Basin:	Delaware River
Stream:	Trout Brook
Date of Inspection:	December 30, 1980

Assessment of General Condition of Dam

Based on visual inspection, past operational performance and Phase I engineering analyses, the dam is assessed as being in fair overall condition.

Based on investigations of the downstream flood plain made in connection with this report, it is recommended that the hazard potential classification be downgraded from high to significant hazard.

Hydraulic and hydrologic analyses indicate that the spillway is inadequate. Discharge capacity of the spillway is not sufficient to pass the designated spillway design flood (100-year storm) without an overtopping of the dam. The spillway is capable of passing approximately 35 percent of the spillway design flood. Therefore, the owner should engage a professional engineer experienced in the design and construction of dams in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of the analyses, the need for and type of remedial measures should be determined and then implemented.

The owner should, in the near future, develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam.

Seepage at the dam should be periodically monitored by an engineer experienced in the design and construction of dams in order to assess any changes in its condition and its effects on the structural stability of the dam.

It is further recommended that the following remedial measures be undertaken by the owner in the near future.

1) The upstream face and crest of the dam should be properly protected against erosion.

2) The spillway should be thoroughly renovated to provide adequate slope protection for the embankment.

3) All trees and adverse vegetation on the embankment should be removed.

The ability to drain the lake should be investigated in the future by a professional engineer experienced in the design and construction of dams. If the need for a low level outlet is determined, a suitable outlet should be designed and installed.

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

Richard J. McDermott, P.E.

John E. Gribbin, P.E.

OVERVIEW - LAKE PLYMOUTH DAM

20 JANUARY 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydraulic and hydrologic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydraulic and hydrologic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LAKE PLYMOUTH DAM, I.D. NJ00818

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Lake Plymouth Dam was made on December 30, 1980. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description of Dam and Appurtenances

The facilities at Lake Plymouth Dam consist of an earthfill embankment with an uncontrolled spillway near its center consisting of a trapezoidal shaped depression in the crest. No outlet works were observed at the time of inspection.

The embankment is approximately 495 feet long and extends approximately west to east. The embankment crest is about 10 feet wide and the downstream slope is 3 horizontal to 1 vertical while the upstream face of the embankment has a slope of 1 horizontal to 1 vertical above the water line.

The principal spillway consists of a two-stage depression in the crest of the embankment lined with grouted riprap. The primary and secondary crests of the spillway have lengths of 14.0 feet and 25.0 feet respectively. The secondary spillway crest elevation is 998.8, National Geodetic Vertical Datum (N.G.V.D.), while the elevation of the primary spillway crest is 998.0, about 2.7 feet below the embankment crest.

Depressions in the soil are located adjacent to the right and left ends of the embankment. The depressions consist of grassy irregularly shaped low areas and serve as emergency spillways. The crests consist of a level section 40 feet long for the west end and 10 feet long for the east end, both at elevation 1000.2.

b. Location

Lake Plymouth Dam is located in the Township of Stillwater, Sussex County, New Jersey. Principal access to the dam is by Owassa Road. The dam is located approximately 6 miles southwest of N.J. Route 206. Discharge from the spillway of the dam flows into Trout Brook.

c. Size and Hazard Classification

The dam is classified in accordance with criteria presented in "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers. Size categories consist of Small, Intermediate and Large while hazard categories are designated as Low, Significant and High.

Size Classification: Lake Plymouth Dam is classified as "Small" size since its maximum storage volume is 216 acre-feet (which is less than 1000 acre-feet) and its height is 13.6 feet (which is less than 40 feet).

Hazard Classification: Visual inspection of the downstream flood plain of the dam together with breach analysis indicate that failure of the dam due to overtopping could cause appreciable property damage to the barns and grounds located 200 feet downstream from the dam. It is not anticipated that dam failure during a storm equivalent to the SDF would cause inundation of the dwelling located approximately 850 feet from the dam. Accordingly, Lake Plymouth Dam is classified as "Significant" hazard.

d. Ownership

Lake Plymouth Dam is privately owned by Mr. Fred Rosenberg. All correspondence should be addressed R.D. #5, Box 256A, Newton, New Jersey 07860.

e. Purpose of Dam

The purpose of the dam is the impoundment of a lake used for recreation.

f. Design and Construction History

Lake Plymouth Dam reportedly was constructed by Brunswick Homes around 1951. Reportedly, no alterations or repairs have been made since the dam was constructed.

g. Normal Operational Procedures

The dam and its appurtenances are operated and maintained by Lake Plymouth Maintenance Association. Repairs are made on an "as needed" basis.

1.3 Pertinent Data

a. Drainage Area	1.20 square miles
b. Discharge at Damsite	
Maximum flood at damsite	Unknown
Outlet Works at pool elevation	N.A.
Spillway capacity at top of dam	646 cfs
c. Elevation (N.G.V.D.)	
Top of Dam	1000.7
Maximum pool-design surcharge	1000.8
Spillway - Primary crest	998.0
- Secondary Crest	998.8
Depressions adjacent to each end of the dam	1000.2
Stream bed at toe of dam	985.3
Maximum tailwater	988.8 (Estimated)

d. Reservoir

Length of maximum pool	1800 feet (Estimated)
Length of recreation pool	1600 feet (Scaled)

e. Storage (Acre-feet)

Recreation pool	62
Maximum pool - design surcharge	221
Top of dam	216

f. Reservoir Surface (acres)

Top of dam	87.7 (Estimated)
Maximum pool - design surcharge	88.0 (Estimated)
Recreation pool	14.7

g. Dam

Type	Earthfill
Length	495 feet
Height	13.6 feet
Sideslopes - Upstream	1 horiz. to 1 vert.
- Downstream	3 horiz. to 1 vert.
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unkown
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Uncontrolled Weir
Length of weir - Primary	14 feet
- Secondary	25 feet

Primary crest elevation	998.0
Secondary crest elevation	998.8
Gates	N.A.
Approach channel	N.A.
Discharge channel	Spillway discharges directly into downstream channel

j. Depressions Adjacent to Each End of Dam (Emergency Spillways)

Type	Irregular Grasssed Channel
Length of weir (left)	40 feet
Length of weir (right)	10 feet
Crest elevation	1000.2
Gates	N.A.
Approach channel	N.A.
Discharge channel	Depressions discharge overland

k. Regulating Outlet

None observed.

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original design of the dam could be obtained.

2.2 Construction

No data or reports pertaining to the construction of the dam are available.

2.3 Operation

No data or reports pertaining to the operations of the dam are available.

2.4 Evaluation

a. Availability

There is no available engineering data pertaining to the original construction of the dam.

b. Adequacy

Available engineering data pertaining to Lake Plymouth Dam is not adequate to be of significant assistance in the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

The validity of engineering data cannot be assessed due to the absence of data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Lake Plymouth Dam was performed on December 30, 1980. by staff members of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1) The embankment of the dam, appurtenant structures and adjacent areas were examined.
2) The embankment and accessible appurtenant structures were measured and key elevations determined by surveyor's level.
3) The embankment, appurtenant structures and adjacent areas were photographed.
4) The downstream flood plain was toured to evaluate downstream development and restricting structures.

b. Dam

The grading of the dam appeared to be generally uniform. The crest was free of almost all vegetation although a few trees were observed. It consisted of bare soil with many roots exposed. The roots may have been exposed due to wind erosion. The soil was black in color, and appeared to be topsoil. The upstream face of the dam was exposed only to the waterline and was covered with grass and trees. Trees ranged in size from 2 inches to 12 inches. The upstream face was also eroded, apparently by wave action. There were also two strands of wire running along the upstream side of the crest of dam attached to trees and posts forming an electrified fence.

The downstream face of the dam was covered with trees and bushes and contained no grass. The trees ranged in size from 1 inch to 18 inches.

At the toe of the dam approximately halfway between the spillway and the left end and also to the right of the spillway there was an area of soft spongy soil which could be an indication of seepage. In addition, two points of possible seepage were observed at the toe of dam, one about 100 feet from the left end and the other about 100 feet from the right end. The former was flowing with a trickle and contained orange colored deposits while the latter consisted of standing water. Small channels about 1 foot to 2 feet wide extended from both of the seepage points.

c. Appurtenant Structures

The concrete in the spillway section appeared to be haphazardly placed and did not form satisfactory stabilization. The sideslopes of the trapezoidal section were stabilized on the left by grouted riprap and contained no significant stabilization on the right. The downstream slope of the spillway was formed by riprap. There were small trees growing in the spillway and on its downstream side. The trees ranged in size from 1 inch to 3 inches. The overall stabilization of the soil in the spillway appeared to be inadequate.

d. Reservoir Area

The entire perimeter of the reservoir except for its upstream end appeared to be surrounded by home sites. The home sites were wooded and the shore slopes were flat to moderate with slopes of about 5 percent. The shore at the upstream end of the dam was wooded and also appeared to have moderate slopes.

e. Downstream Channel

The downstream channel consisted of a small, natural, meandering stream with a bed formed of cobbles and gravel. It had banks ranging from one to four feet high. It was wooded to its waterline and essentially free of obstructions. Approximately 200 feet downstream from the dam, two barns were located adjacent to the stream. The area downstream from the dam as well as the dam itself was being used for grazing horses. A road bridge and dwelling were located about 850 feet downstream from the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Lake Plymouth is regulated by discharge over the spillway and depressions at each end of the dam. The dam does not include a low level outlet, thus precluding a drawdown without the use of pumping or siphoning. Reportedly, the lake is not normally lowered for any purpose.

Reportedly, the stream flowing into the upstream end of the lake normally ceases to flow during the summer and the lake level drops about one foot.

4.2 Maintenance of the Dam

Reportedly, maintenance of the dam is performed on an "as needed" basis.

4.3 Maintenance of Operating Facilities

Reportedly, regular maintenance of operating facilities consists of cleaning the spillway by the Lake Plymouth Maintenance Association.

4.4 Description of Warning System

Reportedly, no warning system is currently in use for the dam.

4.5 Evaluation of Operational Adequacy

The operation of the dam has been successful to the extent that the dam reportedly has not been overtopped.

Maintenance documentation is poor and maintenance has not been adequate in the following areas:

1) Eroded areas of the upstream face of embankment not repaired.

2) Trees and other adverse vegetation not removed.

3) Spillway not properly stabilized.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The quantity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff quantity, called the spillway design flood (SDF), is described in terms of return frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers, the SDF for Lake Plymouth Dam falls in a range of 100-year frequency to 1/2 PMF. In this case, the low end of the range, 100-year frequency, is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The SDF peak computed for Lake Plymouth Dam is 1851 c.f.s. This value is derived from the 100-year flood hydrograph computed by the use of the HEC-1-DAM Flood Hydrograph Computer Program using the Soil Conservation Service triangular unit hydrograph with curvilinear transformation. Hydrologic computations and computer output are contained in Appendix 4.

The spillway discharge rates were computed by the use of weir formulae appropriate for the configurations of the spillway and depressions adjacent to each end of the dam. The combined spillway and emergency spillway discharge with lake level equal to the top of the dam was computed to be 646 c.f.s. The SDF was routed through the dam by use of the HEC-1-DAM computer program using the modified Puls Method. In routing the SDF, it was found that the dam crest would be overtopped by a depth of 0.1 foot in a non-breach situation. Accordingly, the subject spillway is assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

Reportedly, the dam has never been overtopped. No damage to downstream structures has been reported.

c. Visual Observation

No evidence of overtopping of the embankment was noted at the time of inspection.

d. Overtopping Potential

As indicated in paragraph 5.1.a. a storm of magnitude equal to the SDF would cause overtopping of the dam to a height of 0.1 foot over the crest of the dam. The spillway is capable of passing approximately 35 percent of the SDF with lake level equal to the top of dam.

e. Drawdown Data

Drawdown computations cannot be performed due to the apparent lack of outlet works.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The dam appeared, at the time of inspection, to be outwardly stable. However, evidence of seepage was observed at four locations on the downstream side of the dam. The severity of the seepage cannot be precisely determined within the scope of this Phase I evaluation. However, the seepage does not appear to be an indication of immediate structural instability.

b. Generalized Soils Description

The soils description of Lake Plymouth Dam, with respect to glaciation and to bedrock formation, is complex. On the northwest a quartzite conglomerate bedrock, shown on the Geologic Map of New Jersey as Shawangunk conglomerate with a glacial ground Moraine deposited during the Wisconsin Glacial stage. On the southeast, the underlying formation is slate and shale bedrock of Ordovician age. Some mounds created by the accumulation of sand and gravel brought by the melt water flowing from the Wisconsin Glacier surrounds the lake. The quartzite conglomerate bedrock presumably extends below the dam foundations.

c. Design and Construction Data

Analysis of structural stability and construction data for the embankment are not available.

d. Operating Records

No operating records are available for the dam. The water level of Lake Plymouth is not monitored.

e. Post-Construction Changes

No significant changes to the dam or area around the dam since its construction are known.

f. Seismic Stability

Lake Plymouth Dam is located in Seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dam" which is a zone of very low seismic activity. Experience indicates that dams in seismic Zone 1 will have adequate sbability under seismic loading conditions if they have adequate stabi'ity under static loading conditions. Lake Plymouth Dam appeared to be outwardly stable under static loading conditions at the time of inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

sment

ty

d on hydraulic and hydrologic analyses outlined in Section 5
Appendix 4, the spillway of Lake Plymouth Dam is assessed
eing inadequate. The spillway is not able to pass the SDF
out an overtopping of the dam.

embankment appeared, at the time of inspection, to be
ardly stable. However, the evidence of seepage was observed
he toe of dam. The seepage did not appear to be an indication
mediate embankment instability.

acy of Information

rmation sources for this report include 1) field inspection,
SGS quadrangle, 3) consultation with the owner of Lake
outh Dam. The information obtained is sufficient to allow
ase I assessment as outlined in "Recommended Guidelines
Safety Inspection of Dams."

of the absent data are as follows:

Construction and as-built drawings.
Description of fill material for embankment.
Design computations and reports.
Maintenance documentation.
Soils report for the site.
Post construction engineering reports.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Lake Plymouth Dam are not available, additional data are not considered imperative for this Phase I evaluation.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a, the spillway is considered to be inadequate. It is therefore recommended that a professional engineer experienced in the design and construction of dams be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to the spillway capacity. Based on the findings of these analyses, the need for and type of remedial measures should be determined and then implemented.

The owner should, in the near future, develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam.

It is further recommended that the following remedial measures be undertaken by the owner in the near future.

1) The upstream face and crest of the dam should be properly protected against erosion.

2) The spillway should be thoroughly renovated to provide adequate slope protection for the embankment.

3) All trees and adverse vegetation on the embankment should be removed.

b. Maintenance

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

c. Additional Studies

Seepage at the dam should be periodically monitored by an engineer experienced in the design and construction of dams in order to assess any changes in its condition and its effects on the structural stability of the dam.

The ability to drain the lake should be investigated in the future by a professional engineer experienced in the design and construction of dams. If the need for a low level outlet is determined, a suitable outlet should be designed and installed.

PLATES

LAKE PLYMOUTH DAM

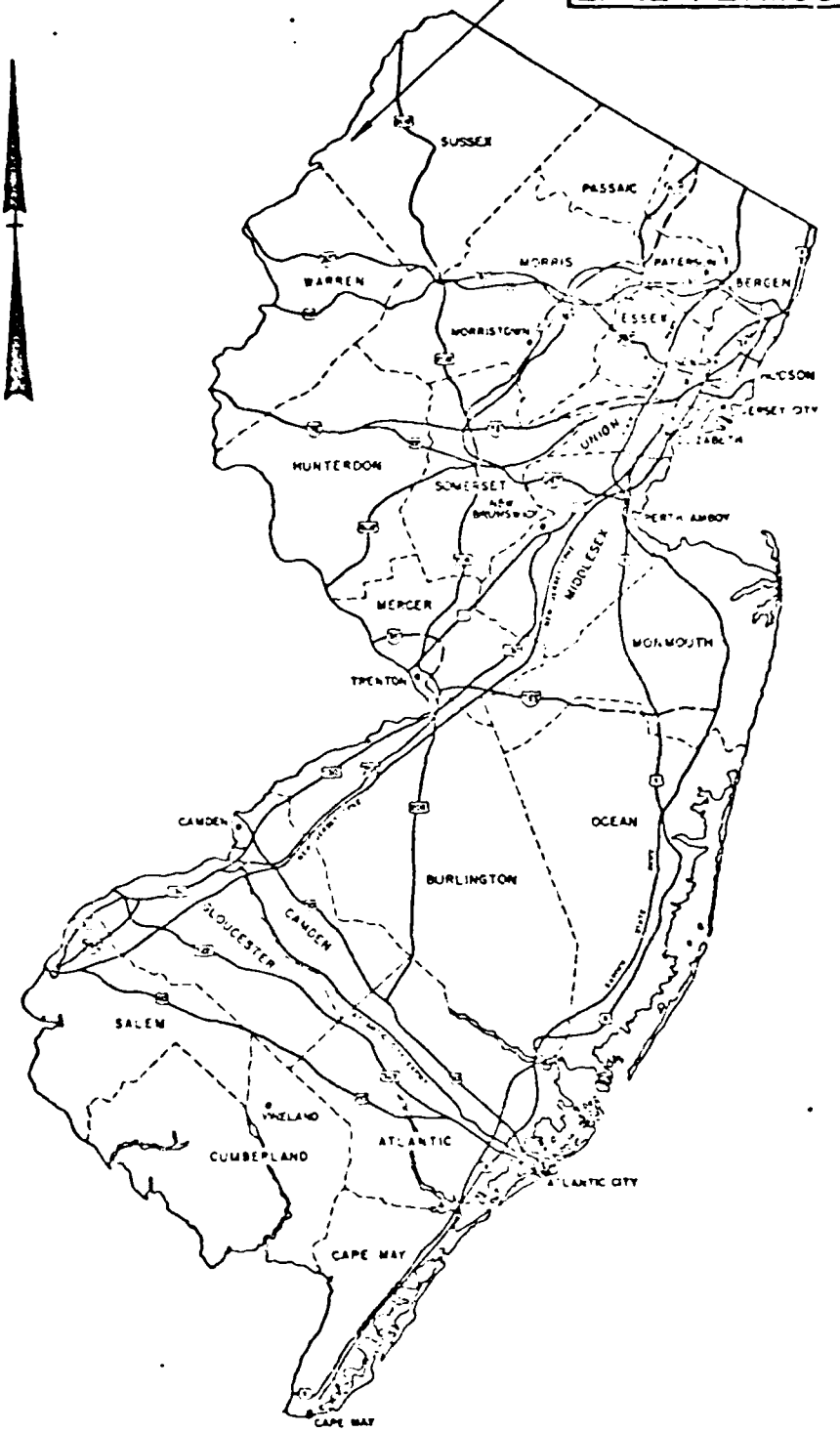
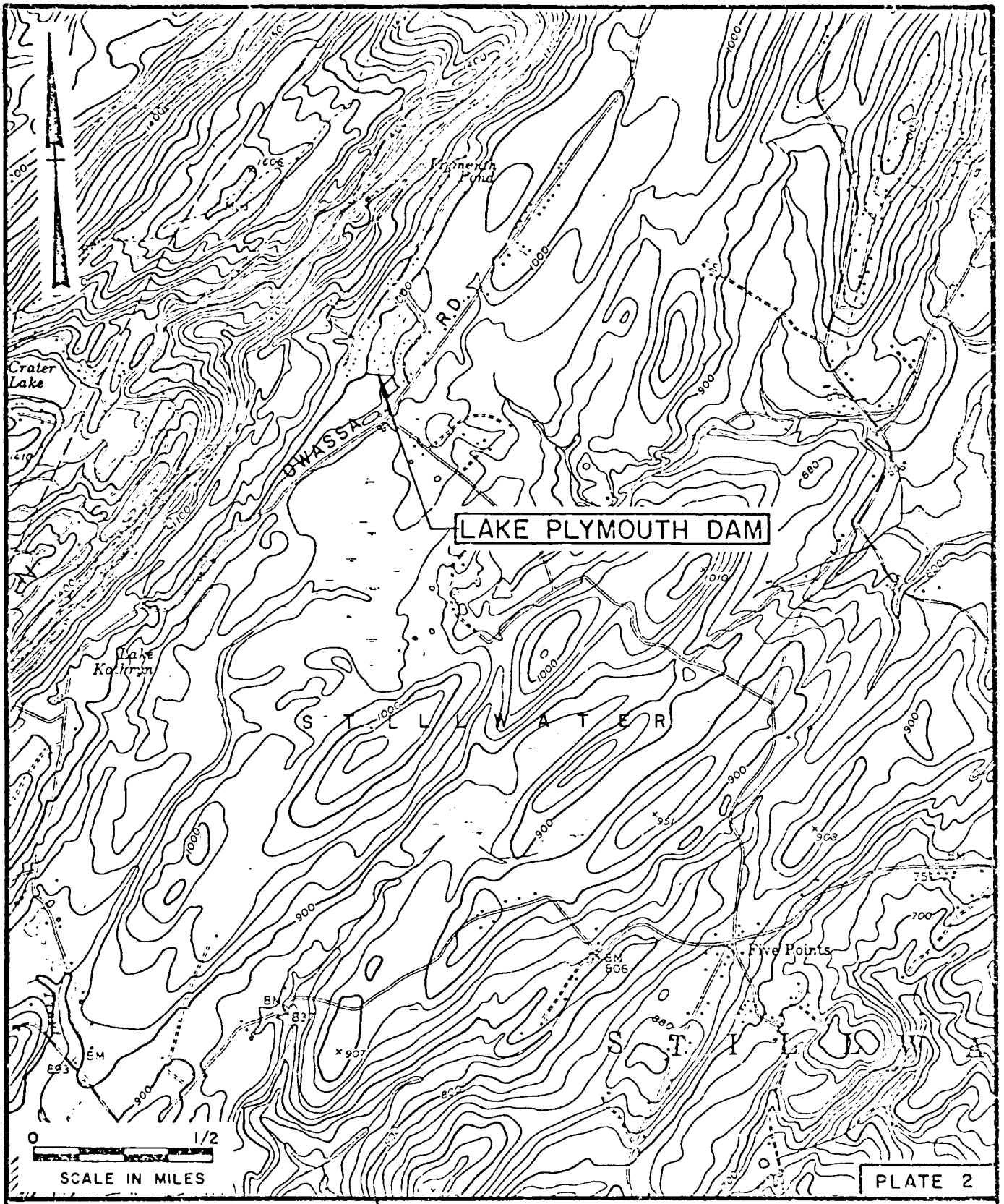


PLATE 1

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS **KEY MAP** LAKE PLYMOUTH DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	SCALE: NONE DATE: FEB. 1981



STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

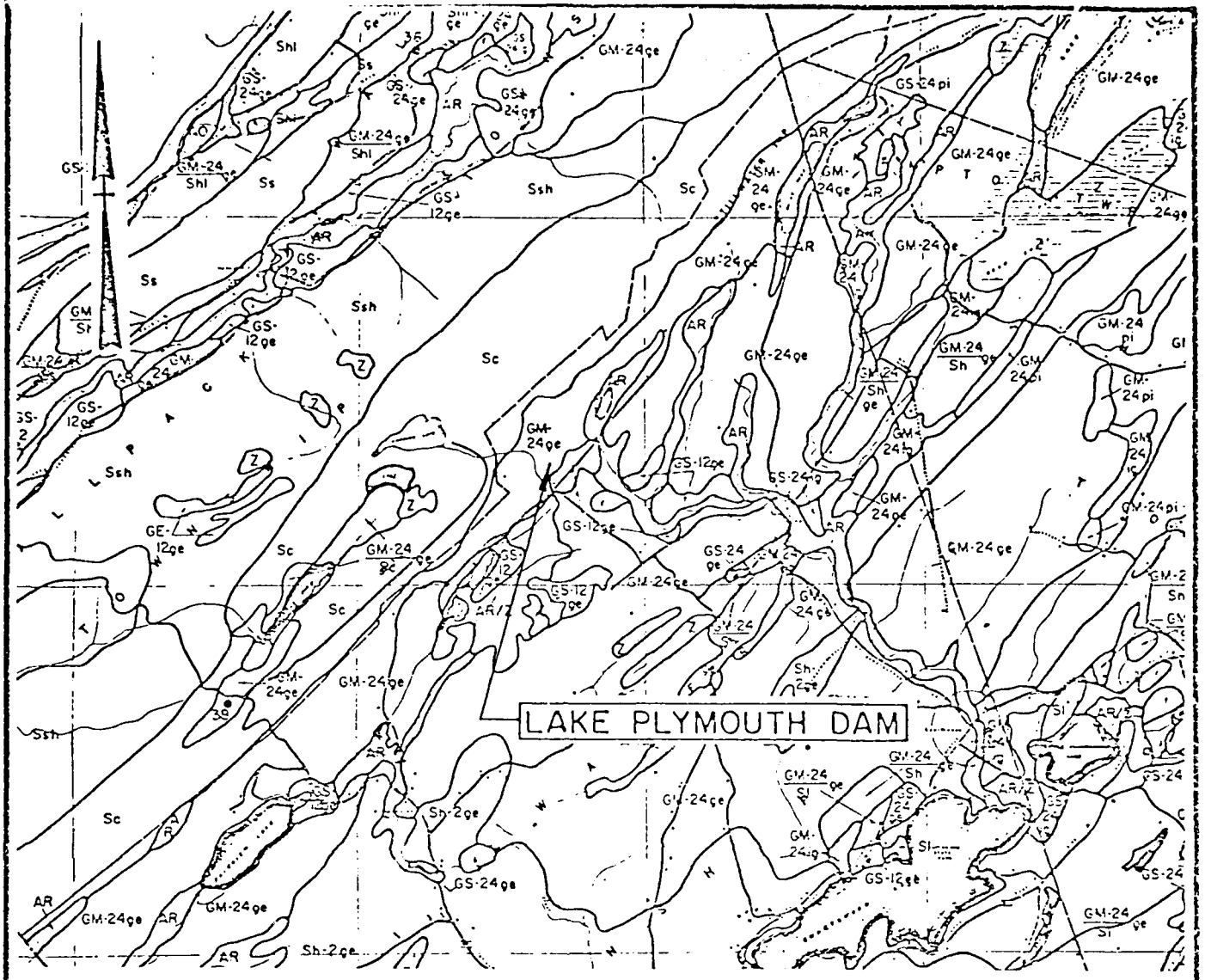
INSPECTION AND EVALUATION OF DAMS

VICINITY MAP

LAKE PLYMOUTH DAM

SCALE: AS SHOWN

DATE: FEB. 1981



Legend

GM-24 Glacial ground moraine, composed of unconsolidated, unstratified material deposited during the Wisconsin glacial stage.

GS-12 Glacial stratified drift deposited by melt waters flowing from the Wisconsin glacier.

Note: Information taken from Rutgers University, Soil Survey of New Jersey, Report No. 11, Sussex County, November 1953 and Geologic Map of New Jersey prepared by J.V. Lewis and H. Kummel 1910-1912, revised by H.B. Kummel 1931 and M. Johnson 1950.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY.

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

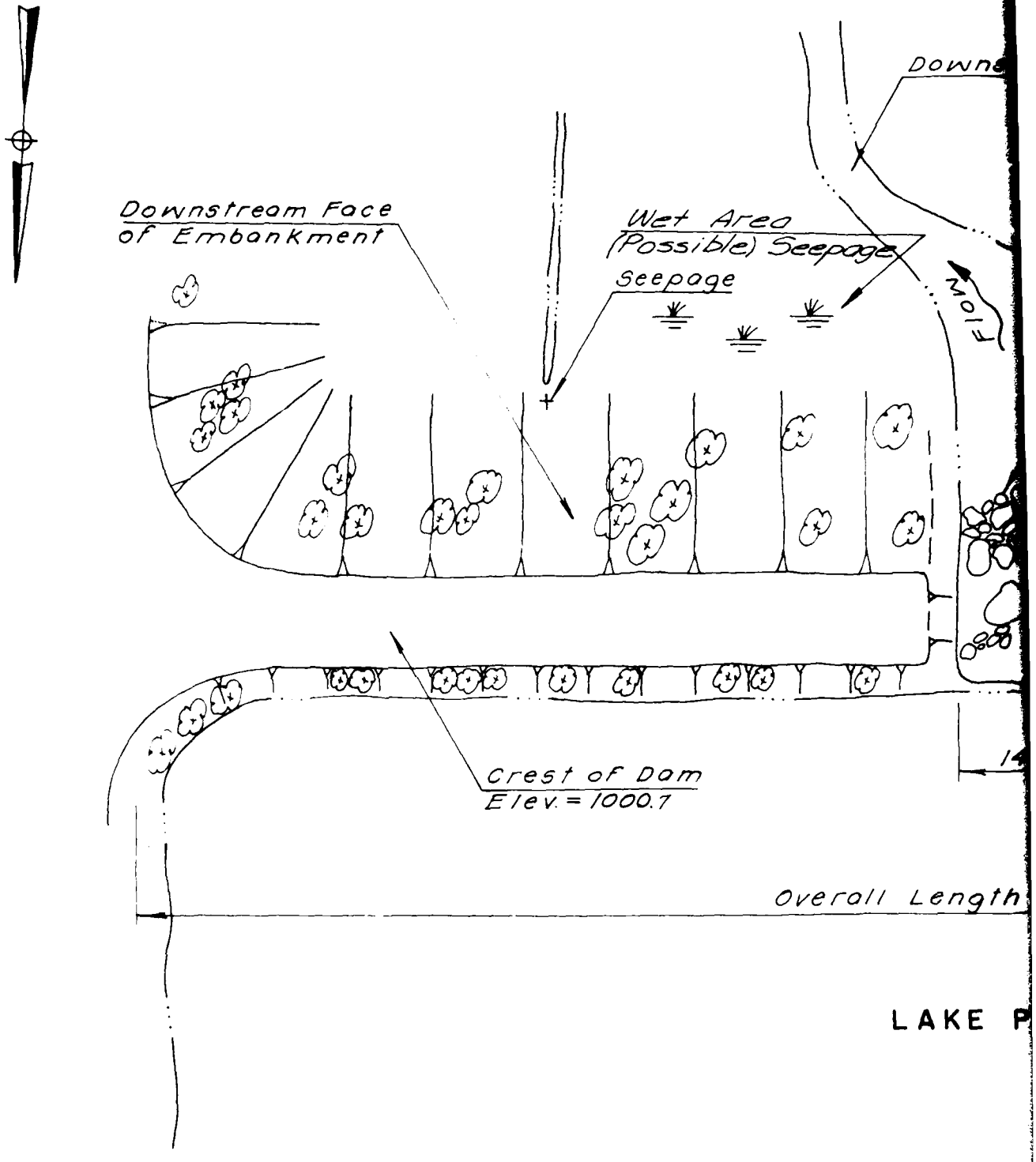
INSPECTION AND EVALUATION OF DAMS

SOIL MAP

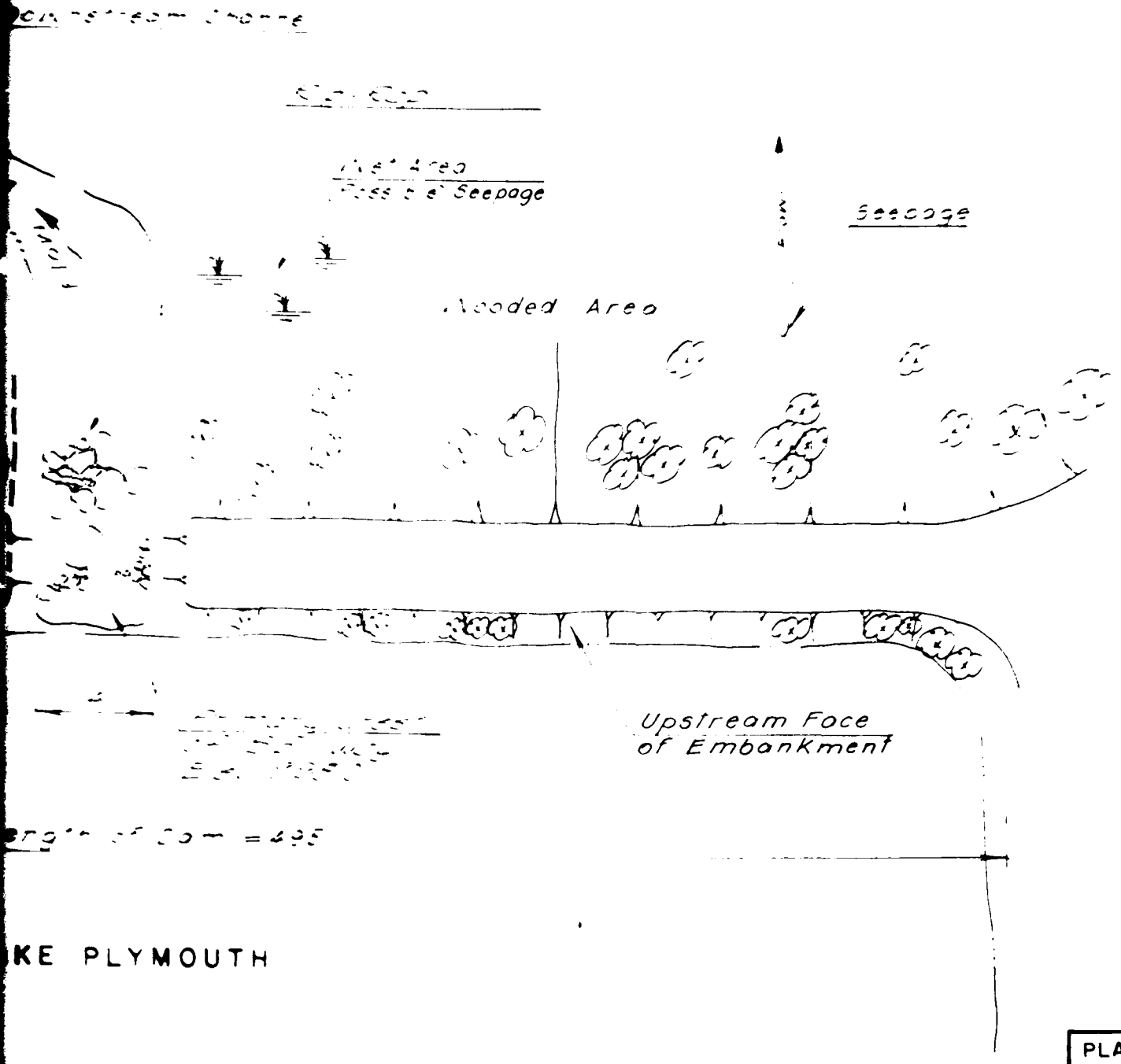
LAKE PLYMOUTH DAM

SCALE: NONE

DATE: FEB.1981



Note:
Information taken from field inspection December 30, 1980



KE PLYMOUTH

PLATE 4

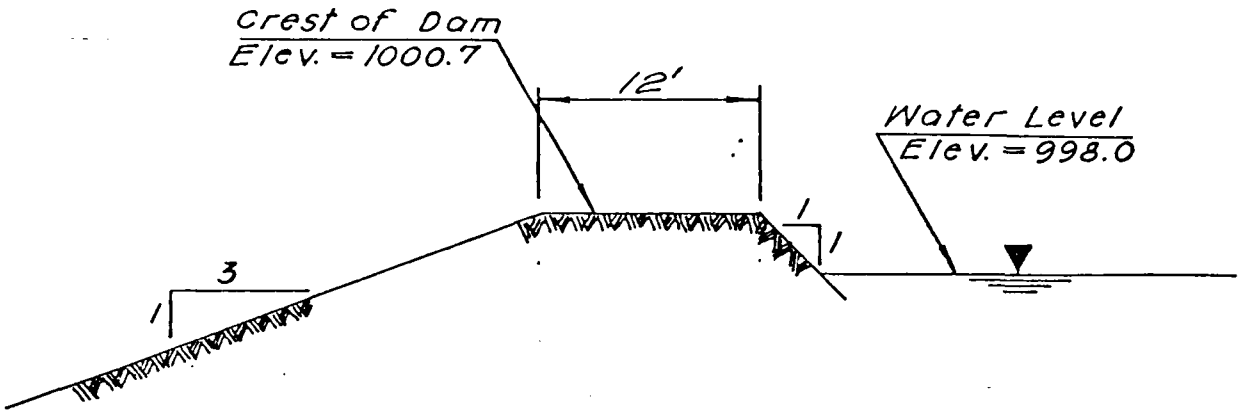
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

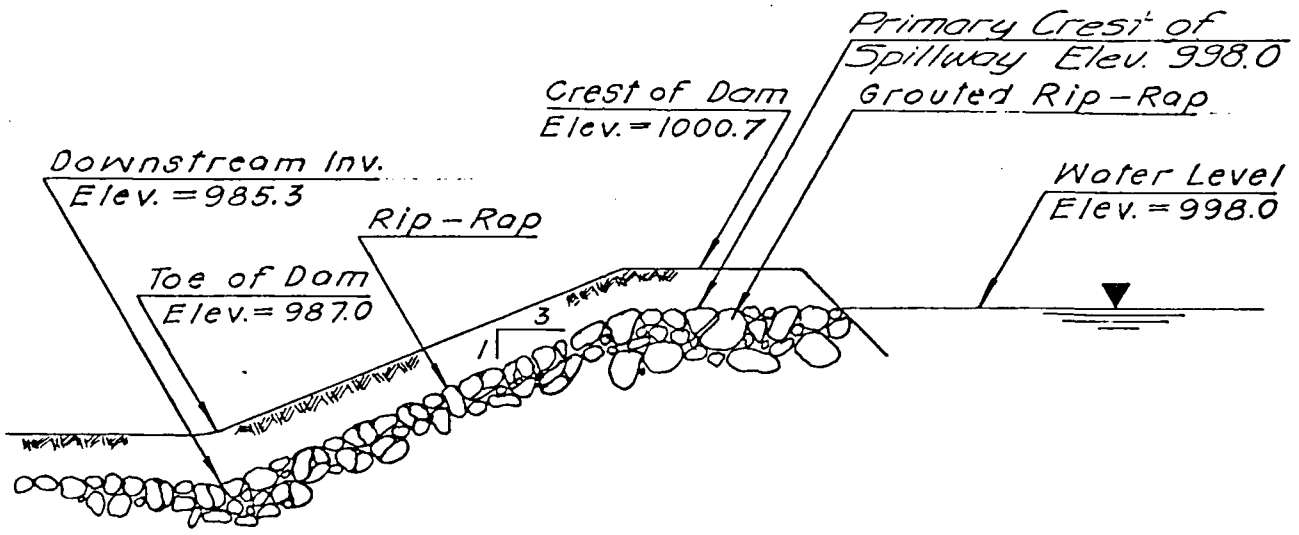
GENERAL PLAN

LAKE PLYMOUTH DAM

I.D. N J. 00818	SCALE: NOT TO SCALE
	DATE: FEB. 1981



TYPICAL DAM SECTION

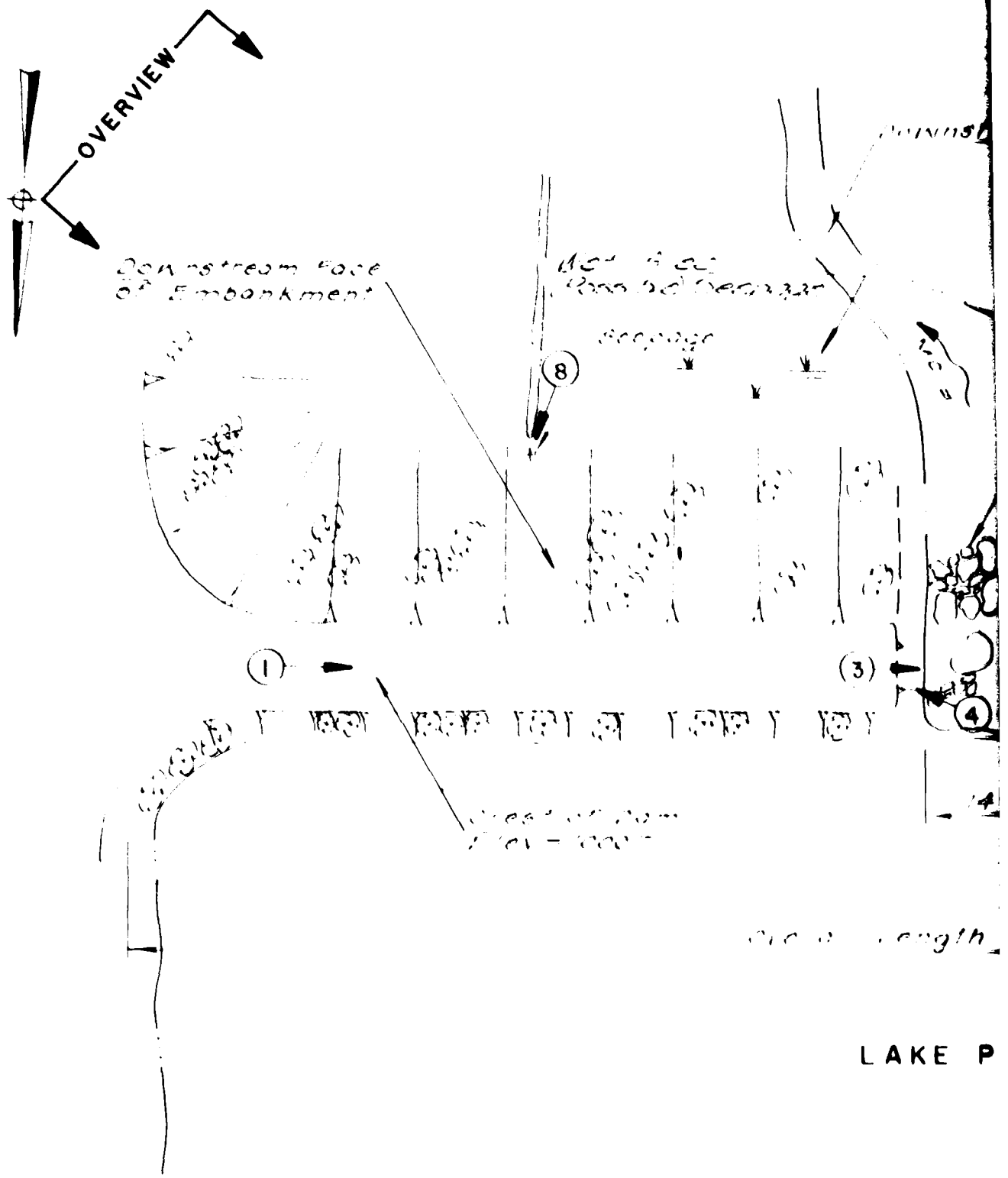


TYPICAL SPILLWAY SECTION

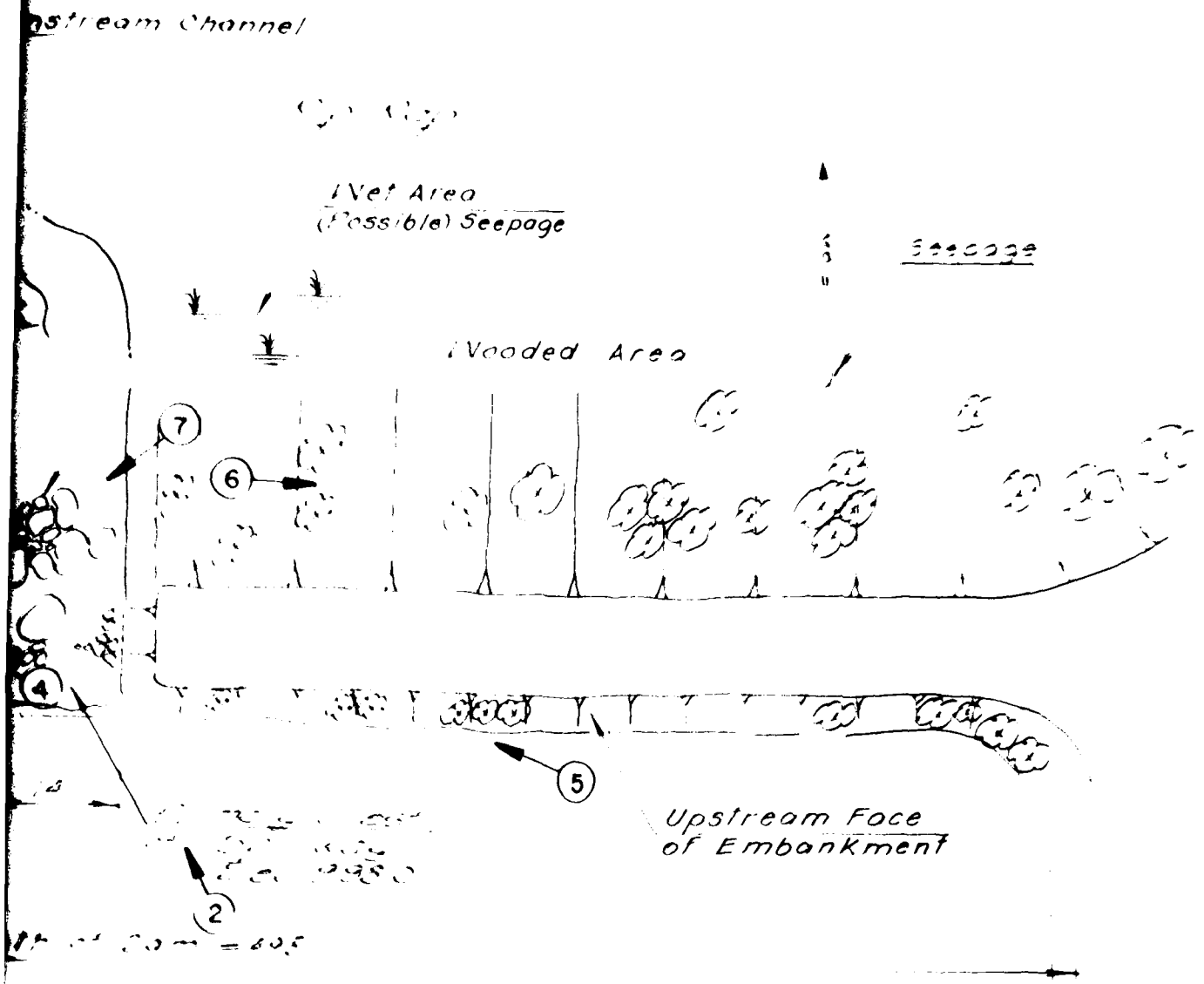
Note:
Information token from field inspection December 30, 1980

PLATE 5

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS SECTIONS LAKE PLYMOUTH DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D.N.J. 00818 | SCALE: NONE DATE: FEB. 1981



Note:
Information taken from field inspection December 30, 1980



PLYMOUTH

PLATE 6

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

LAKE PLYMOUTH DAM

I D N.J.00818	SCALE: NOT TO SCALE
	DATE: FEB. 1981

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List

Visual Inspection

Phase I

Name of Dam Lake Plymouth County Sussex State N. J. Coordinators NJDEP

Date(s) Inspection 12/30/81 Weather Sunny Temperature 25°F.

Pool Elevation at time of Inspection 998.0 M.S.L. Tailwater at Time of Inspection 985.5 M.S.L.

Inspection Personnel:

John Gribbin Mark Brady

Charles Osterkorn Richard McDermott

Daniel Buckelew

John Gribbin Recorder

Present: Fred Rosenberg, owner.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Crest generally bare topsoil with a few trees observed. Tree roots exposed. Side slopes covered with grass, brush and trees (1" to 18"). Electrified fence extends along upstream side of crest.	Trees and adverse vegetation should be removed.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appeared stable.	
ANY NOTICEABLE SEEPAGE	Wet, spongy soil at toe halfway between spillway and left end and to right of spillway. Two points of seepage at toe about 100' from each end. Left seepage point was flowing with a trickle and contained orange deposits. Right seepage point consisted of standing water. Small channels (1' to 2' wide) extended from both.	Observed seepage should be monitored.
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

EMBANKMENT

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Crest of the dam eroded and free of vegetation possibly due in part to wind. Upstream face eroded by wave action.	Eroded areas should be properly stablized.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical: generally level. Horizontal: straight.	
RIPRAP	Riprap observed on spillway and downstream face of dam (See spillway)	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES IN OUTLET CONDUIT	N/A	None observed.
INTAKE STRUCTURE	N/A	
OUTLET STRUCTURE	N/A	
OUTLET CHANNEL	N/A	
GATE AND GATE HOUSING	N/A	

SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	Trapezoidal cut in crest of dam stabilized by grouted riprap in poor condition. Lower, primary stage appeared to have been formed by erosion.	Slope protection in spillway should be renovated.
APPROACH CHANNEL	N/A	
DOWNSTREAM FACE	Formed by riprap on downstream face of dam. Condition appeared fair.	
DISCHARGE CHANNEL	Natural stream with bottom consisting of cobbles and gravel.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Wooded homesites surrounding reservoir with flat to moderate slope of approx. 5%	
SEDIMENTATION	Unknown	
STRUCTURES ALONG BANKS	Entire perimeter of reservoir surrounded by home sites.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTION, DEBRIS, ETC.)	Natural meandering channel with streambed lined with cobbles and gravel. Road bridge located 1050' downstream. Barns and fenced in area for horses located immediately downstream of dam.	
SLOPES	Banks generally 3' to 4' high. Generally flat floodplain 200' to 300' wide.	
STRUCTURES ALONG BANKS	Road bridge located 1050' downstream. Dwelling adjacent to channel 1050' downstream approx. 10' above streambed. Barns adjacent to channel 200' and 1050' downstream approx. 2' and 8' above streambed, respectively.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM			REMARKS
DAM	-	PLAN	Not Available
		SECTIONS	
SPILLWAY	-	PLAN	Not Available
		SECTIONS	
		DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS			Not Available
OUTLETS	-	PLAN	Not Available
		DETAILS	
		CONSTRAINTS	
		DISCHARGE RATINGS	
HYDRAULIC/HYDROLOGIC DATA			Not Available
RAINFALL/RESERVOIR RECORDS			Not Available
CONSTRUCTION HISTORY			Not Available
LOCATION MAP			Not Available

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM INSTABILITY SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	Not Available
MODIFICATIONS	Not Available
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Not Available
MAINTENANCE OPERATION RECORDS	Not Available

APPENDIX 2

Photographs

PHOTO 1

CREST OF DAM

PHOTO 2

UPSTREAM VIEW OF SPILLWAY

LAKE PLYMOUTH DAM
30 DECEMBER 1980

PHOTO 3

CREST OF SPILLWAY

PHOTO 4

GROUTED RIPRAP AT LEFT END OF SPILLWAY CREST

LAKE PLYMOUTH DAM
30 DECEMBER 1980

PHOTO 5

UPSTREAM FACE OF DAM

PHOTO 6

DOWNSTREAM FACE OF DAM

LAKE PLYMOUTH DAM
30 DECEMBER 1980

PHOTO 7

RIPRAP ON DOWNSTREAM SIDE OF SPILLWAY

PHOTO 8

SEEPAGE AT TOE OF DAM

LAKE PLYMOUTH DAM
30 DECEMBER 1980

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Steep, wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 998.0 (62 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 1000.8

ELEVATION TOP DAM: 1000.7

PRINCIPAL SPILLWAY CREST:

a. Elevation 998.0 (Primary), 998.8 (Secondary)

b. Type Broad Crested Weir with inclined downstream side

c. Width 12 feet

d. Length 14 feet (Primary), 25 feet (Secondary)

e. Location Spillover Downstream side of dam

f. Number and Type of Gates None

AUXILIARY SPILLWAY CREST: Depressions adjacent to ends of dam

a. Elevation 1000.2

b. Type Irregular grassed channel

c. Width N.A.

d. Length 40 feet (left), 10 feet (right)

e. Location Spillover Adjacent to ends of dam

f. Number and Type of Gates N.A.

OUTLET WORKS: None

a. Type N.A.

b. Location N.A.

c. Entrance Invert N.A.

d. Exit Invert N.A.

e. Emergency Draindown Facilities: N.A.

HYDOMETEOROLOGICAL GAGES: None

a. Type N.A.

b. Location N.A.

c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake Stage Equal to Top of Dam) 646 c.f.s.

APPENDIX 4

Hydraulic/Hydrologic Computations

HYDROLOGY

HYDROLOGIC ANALYSIS:

Inflow hydrograph for LAKE PLYMOUTH DAM will be developed by HEC-1-DAM computer program using SCS Triangular unit hydrograph and curvilinear transformation

DRAINAGE AREA = 1.2 [Sq mi]

INFILTRATION:

Drainage area is Wooded use:

Initial infiltration	1.5 [IN]
constant infiltration	0.15 [IN/HR]

TIME OF CONCENTRATION: [by SCS-TR-55]

Length	of overland flow	= 2,400	[Ft]
average	slope	= 16.6	[%]
average	velocity	= 1.08	[Ft p s]
Length	of storm drain	= 4,800	[Ft]
average	slope	= 7.29	[%]
average	velocity	= 4.55	[Ft p s]

$$T_c = \left[\frac{2400}{1.08} + \frac{4800}{4.55}\right]\frac{1}{3600} = 0.61 + 0.29$$

$$T_c = 0.9 \text{ [Hr]}$$

TIME OF CONCENTRATION:

[by Handbook of applied hydrology - Chow pg 14-36]

$$t^{2.14} = \frac{2}{3}\,\frac{L \cdot \eta}{\sqrt{S}}$$

$$t^{2.14} = \frac{2}{3}\,\frac{2400 \times 0.4}{\sqrt{0.0166}}$$

T_c = Time of concentration [min]
S = slope [%]
η = 0.4 Roughness coefficient
l = length of overland [Ft]

$$t = 0.678 \text{ [Hr]}$$

overland flow

$$T_c = 0.68 + 0.29 = 0.97 \text{ [Hr]}$$

TIME OF CONCENTRATION:

[by Design of small dams, Pg 71]

$$T_c = \left[\frac{11.9 L^3}{H}\right)^{0.385}$$

$$T_c = \left[\frac{11.9(1.36)^3}{440}\right]^{0.385}$$

T_c = Time of concentration [Hr]
L = Length of watercourse [Mi]
H = Elevation difference

$$T_c = 0.36 \text{ [Hr]}$$

COMPUTER INPUT:

FOR HEC-1-DAM INPUT

USE LAG TIME

T_c = 0.9 Hr LAG 60% T_c

LAG TIME = 0.54 hr.

PRECIPITATION :

24 Hours, 100 year rainstorm distribution for LAKE PLYMOUTH DAM

Time [Hr]	Rain [IN]
1	0.08
2	0.08
3	0.08
4	0.08
5	0.08
6	0.08
7	0.09
8	0.09
9	0.18
10	0.18
11	0.18
12	0.19
13	0.30
14	0.30
15	0.80
16	3.00
17	0.40
18	0.30
19	0.19
20	0.18
21	0.09
22	0.09
23	0.08
24	0.08
24 Hr	7.20

From TP40 U.S. WEATHER BUREAU

LAKE STORAGE VOLUME:

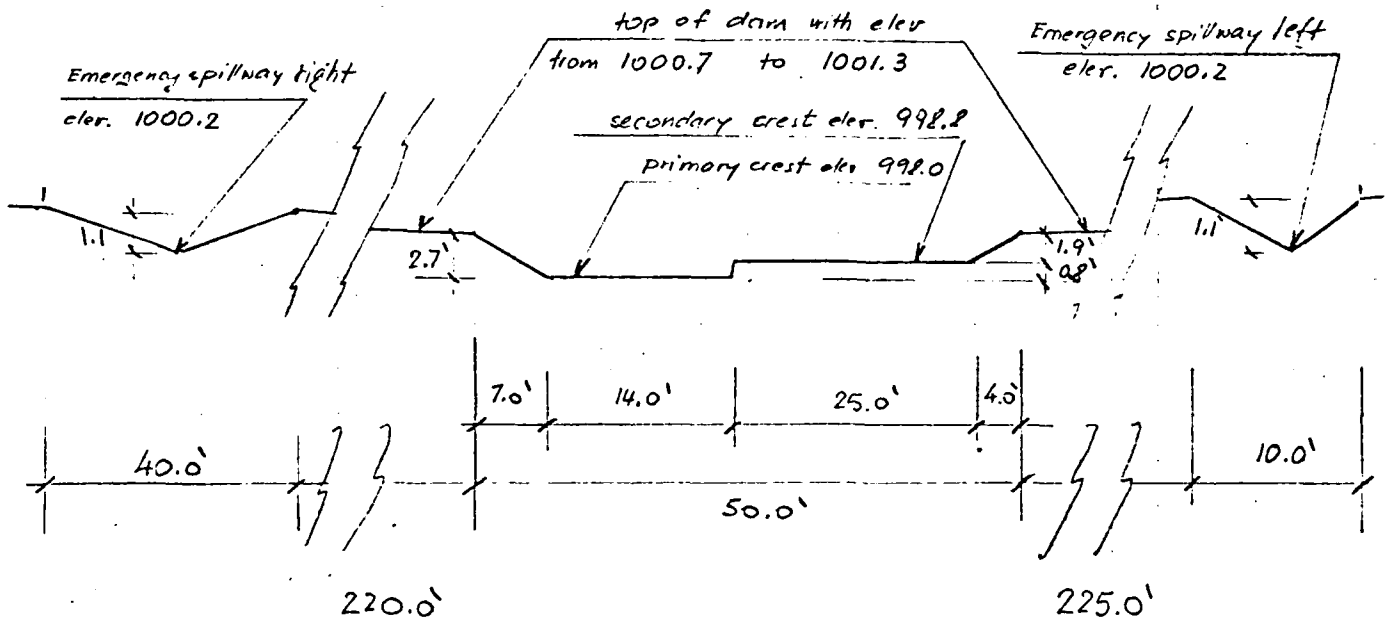
Water surface elev. [Ft]	Area [Ac]
985.3	0
998.0	14.7
1,000.0	87.7
1,020.0	110.7
1,040.0	149.7

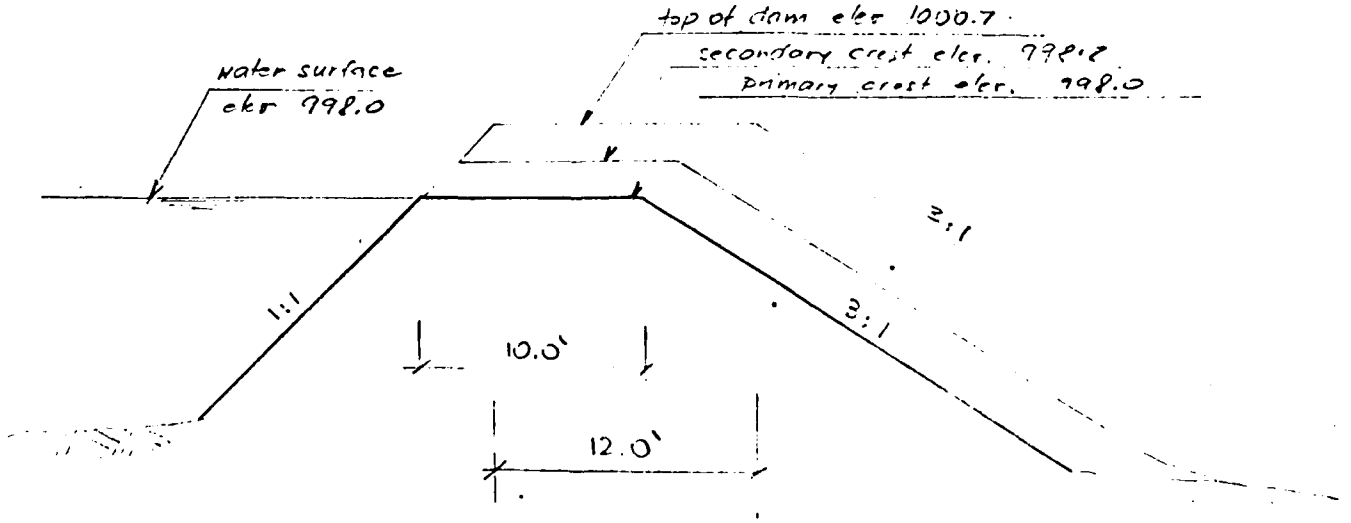
HEC-1-DAM Program will develop storage capacity from surface, area & elevations, information taken from U.S.G.S Quadrangle, Flatbrookville, N.J.

HYDRAULICS

DISCHARGE:

The discharge at the LAKE PLYMOUTH DAM is over a principal spillway having primary and secondary stages consisting of broad crested weirs. On the left and on the right side of the dam are two grassed depressions that serve as emergency spillways





SPILLWAY SECTION

[Handbook of hydraulics Pg. 5-45]

$$Q = C L H^{3/2}$$

Q - discharge [cfs]

C - coefficient of discharge

L - effective length of spillway being overtopped [Ft]

H - head total on spillway [Ft]

For hydraulics analysis, the spillway at the Lake PLYMOUTH DAM is assumed to be a broad crested weir with crest elevation 998.0 (primary) and elevation 998.8 (secondary) with varying efective leugths due to the irregular nature of the crest and the trapezoidal shape.

STORCH ENGINEERS

Project LAKE PLYMOUTH DAM Made By JMG Date 5/17/81

Chkd By JG Date 5/18/81

Sheet 8 of 12

SPILLWAY STAGE DISCHARGE TABULATION

Water elev. [Ft]	Primary crest Elev. = 998.0				Secondary crest Elev. = 998.8				Emergency crest left & right Elev. = 1000.2					Σ Q
	H [Ft]	L [Ft]	C	Q [cfs]	H [Ft]	L [Ft]	C	Q [cfs]	$H_{L,R}$ [Ft]	L_L [Ft]	L_R [Ft]	$C_{L,R}$	$Q_{L,R}$ [cfs]	[cfs]
998.0	0	14	0	0	0	0	0	0	0	0	0	0	0	0
998.8	0.8	16.2	3.14	36.4	0	25	0	0	0	0	0	0	0	36.4
1000.2	2.2	20.1	3.56	233.5	1.4	28.3	3.42	160.3	0	0	0	0	0	393.9
1000.7	2.7	21.5	3.57	340.5	1.9	29.4	3.56	274.1	0.5	20.0	10.1	2.91	30.9	645.6
1001.3	3.3	21.5	3.59	462.7	2.5	29.4	3.57	414.9	1.1	40.1	20.2	3.32	230.9	1108.5
1002.0	4.0	21.5	3.62	622.6	3.2	29.4	3.59	604.2	1.3	40.1	20.2	3.56	518.4	1745.2
1003.0	5.0	21.5	3.68	884.6	4.2	29.4	3.63	918.6	2.3	40.1	20.2	3.58	1011.4	2814.6
1004.0	6.0	21.5	3.70	1169.1	5.2	29.4	3.69	1286.4	3.3	40.1	20.2	3.62	1616.9	4072.4

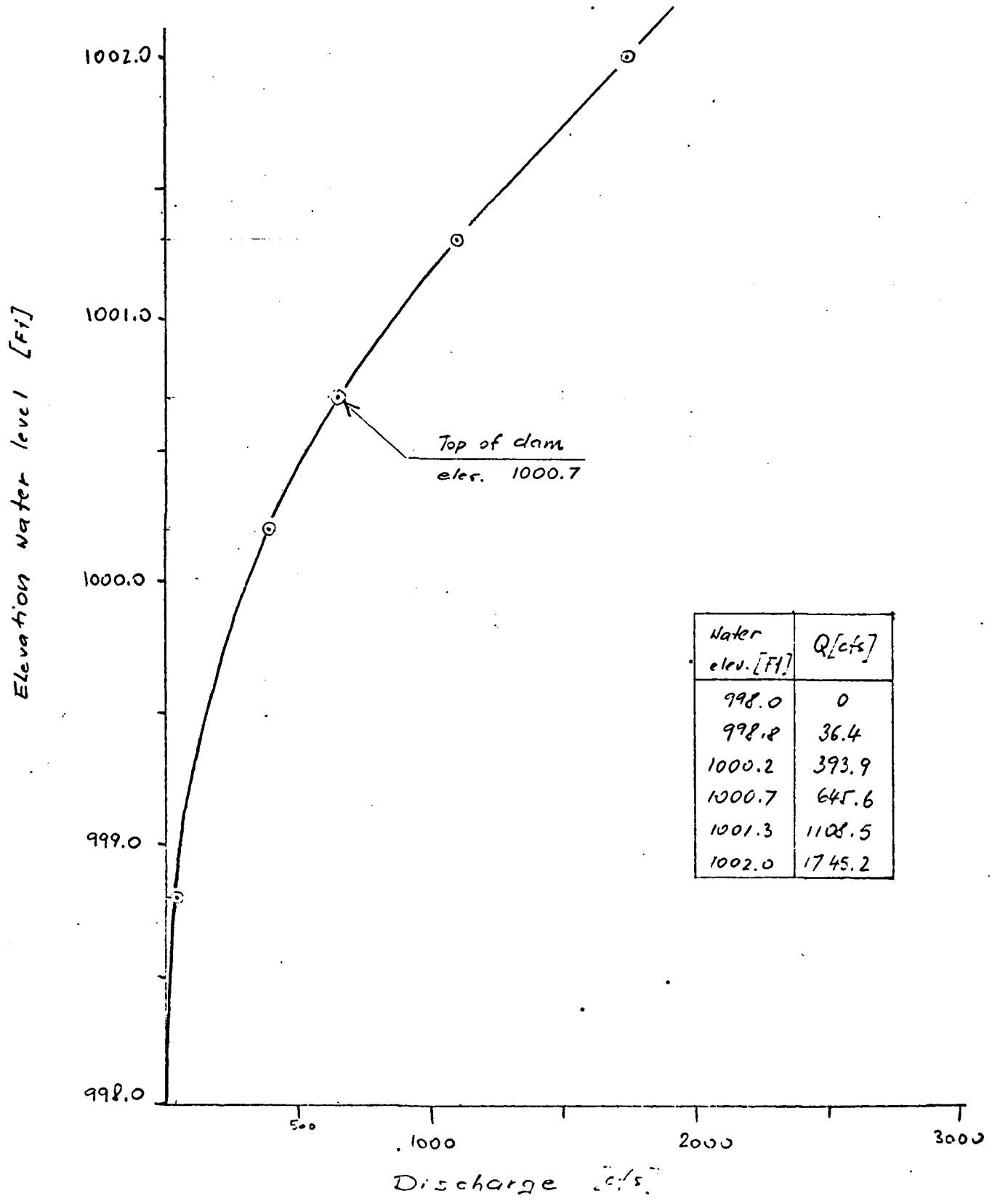
STORCH ENGINEERS

Sheet 9 of 12

Project LAKE PLYMOUTH DAM Made By JHa Date 3/17/81

Chkd By JG Date 3/18/81

SPILLWAY STAGE DISCHARGE CURVE:

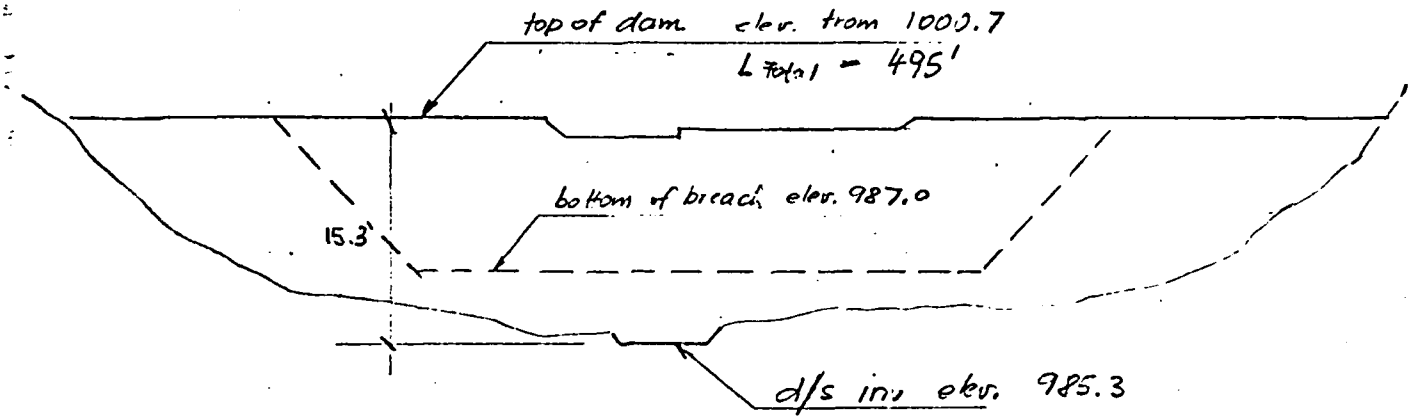


Water elev. [Ft]	Q [cfs]
998.0	0
998.8	36.4
1000.2	393.9
1000.7	645.6
1001.3	1108.5
1002.0	1745.2

Project LAKE PLYMOUTH DAM Made By JHA Date 3/17/81

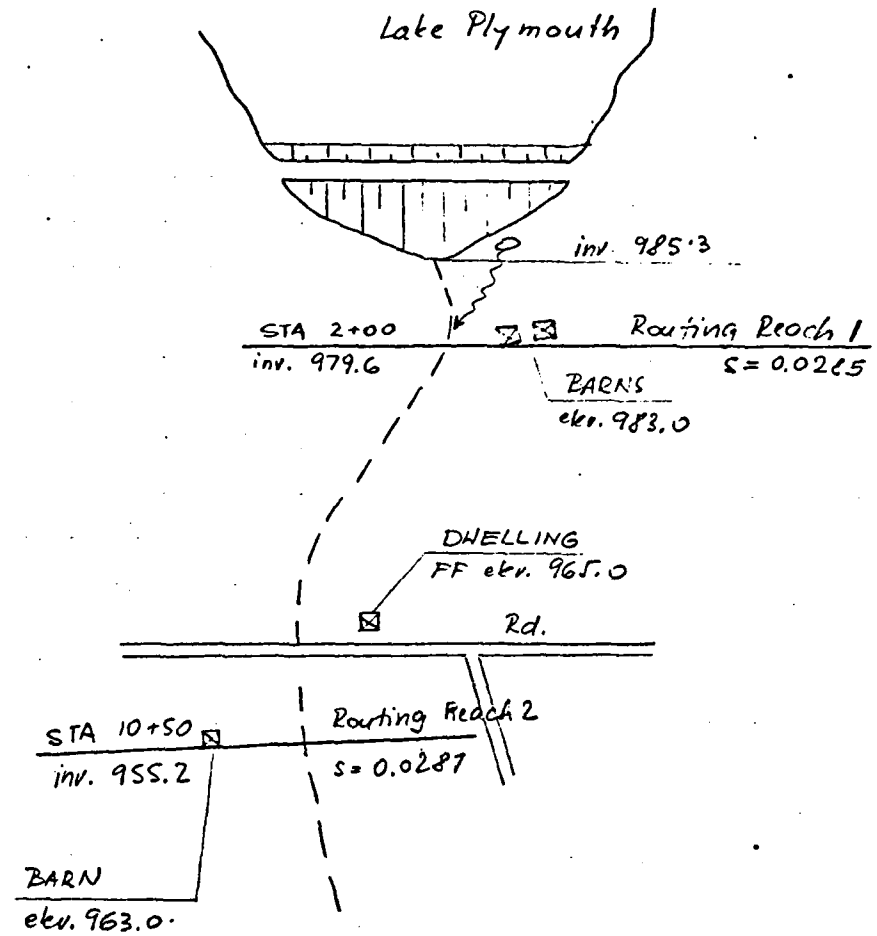
Chkd By JG Date 3/18/81

BREACH ANALYSIS:



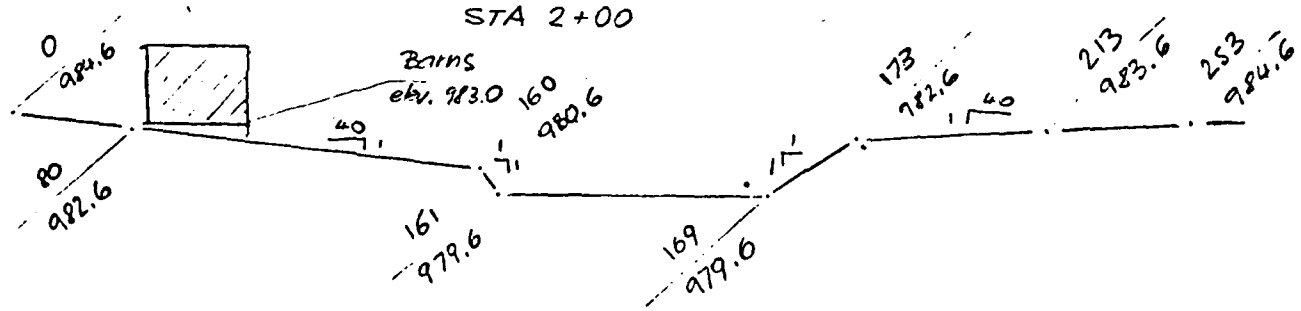
Bottom of breach efective width	=	150'
Bottom of breach elevation	=	987.0
Side slope of breach	=	1:1
Water surface elevation	=	998.0
Water surface elev., which will cause dam to fail	=	1000.7
Time for breach to develop max. size	=	1.0 Hr

DOWNSTREAM CHANNEL

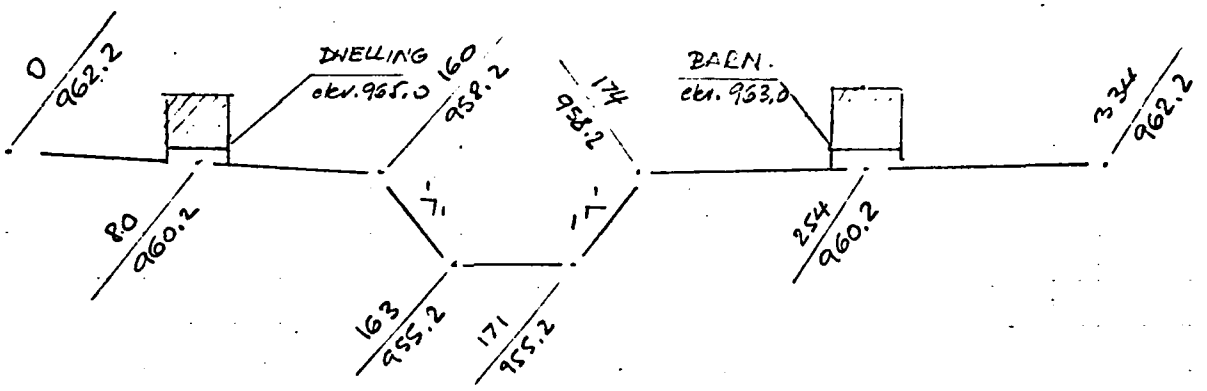


TYPICAL CROSS SECTION

Reach 1
STA 2+00



Reach 2
STA 10+50



BREACH RESULTS

1. Peak outflow = 6593 [cfs]

2. Max. channel stage

Reach 1 inv. elev. = 979.6 [Ft]
max. stage elev. = 985.6

the buildings (barn elev. 983.0) will be inundated by 2.6 ft.

Reach 2 inv. elev. = 955.2 [ft]
max. stage elev. = 962.0

buildings (elev. 965.0 & 963.0) will not be inundated.

HEC - 1 - DAM PRINTOUT

Overtopping Analysis

```
1A1                        NATIONAL DAM SAFETY PROGRAM
A2                              LAKE PLYMOUTH DAM
A3                           100 YEAR STORM ROUTING
B     300        0       15                          0       0       4
B1      5
J       1        1        1
J1      1
K       0   LAKE                        0       0       1
K1        INFLOW HYDROGRAPH TO LAKE PLYMOUTH DAM
M       0        2      1.2             1.2       0                       1
O       96
O1  0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019
O1  0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019
O1  0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019
O1  0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019
O1  0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.019    0.038    0.038
O1  0.038    0.038    0.038    0.038    0.038    0.038    0.038    0.038    0.038    0.038
O1  0.083    0.083    0.083    0.083    0.163    0.163    0.163    0.163    0.750    0.750
O1  0.750    0.750    0.163    0.163    0.163    0.163    0.083    0.083    0.083    0.083
O1  0.083    0.083    0.083    0.083    0.038    0.038    0.038    0.038    0.038    0.038
O1  0.038    0.038    0.038    0.038    0.038    0.038
T                                                        1.5     0.15
W2             0.54
X    -1.0     -0.05      2.0
K       1      DAM                                       1
K1        ROUTE DISCHARGE THROUGH DAM
Y                                       1        1
Y1      1                                                -998.0      -1
Y4  998.0    998.8   1000.2   1000.7   1001.3   1002.0   1003.0
Y5      0     36.4    393.9    645.6   1108.5   1745.2   2814.6
$A      0     14.7     87.7    110.7    149.7
$E  985.3    998.0   1000.0   1020.0   1040.0
$$  998.0
$D1000.7      2.7      1.5      445
K       1        1                                       1
K1        CHANNEL ROUTING REACH 1
Y                                       1        1
Y1      1
Y6  0.050    0.035    0.050    979.6    984.6      200   0.0285
Y7      0    984.6       80    982.6      160    980.6      161    979.6      169    979.6
Y7    173    982.6      213    983.6      253    984.6
K       1        2                                       1
K1        CHANNEL ROUTING REACH 2
Y                                       1        1
Y1      1
Y6  0.050    0.035    0.050    955.2    962.2        8   0.0[illegible]
Y7      0    962.2       80    960.2      160      95[illegible]      16[illegible]    955.2      171    955.2
Y7    174    938.2      254    960.2      334    962.2
K      99
A
```

NATIONAL DAM SAFETY PROGRAM
LAKE PLYMOUTH DAM
100 YEAR STORM ROUTING

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTID= 1 LRTID= 1

RTIOS= 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO LAKE PLYMOUTH DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	1.20	0.00	1.20	0.00	0.000	0	1	0

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.50	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .54

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
0													
									SUM	7.12	4.33	2.79	14586.
										(181.)(	110.)(	71.)(	413.03)

HYDROGRAPH ROUTING

ROUTE DISCHARGE THROUGH DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-998.	-1

STAGE	998.00	998.80	1000.20	1000.70	1001.30	1002.00	1003.00
FLOW	0.00	36.40	393.90	645.60	1108.50	1745.20	2814.60
SURFACE AREA=	0.	15.	88.	111.	150.		
CAPACITY=	0.	62.	154.	2134.	4728.		
ELEVATION=	985.	998.	1000.	1020.	1040.		

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
998.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1000.7	2.7	1.5	445.

PEAK OUTFLOW IS 707. AT TIME 19.00 HOURS

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1
				1.00
HYDROGRAPH AT	LAKE	1.20	1	1851.
		(3.11)		(52.42)(
ROUTED TO	DAM	1.20	1	707.
		(3.11)		(20.02)(
ROUTED TO	1	1.20	1	704.
		(3.11)		(19.94)(
ROUTED TO	2	1.20	1	703.
		(3.11)		(19.90)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	998.00	998.00	1000.70
STORAGE	62.	62.	216.
OUTFLOW	0.	0.	646.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1000.76	.06	221.	707.	1.00	19.00	0.00

PLAN 1 STATION 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	704.	902.5	19.00

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	703.	959.0	19.25

HEC - 1 - DAM PRINTOUT

Breach Analysis

```
IA1                          NATIONAL DAM SAFETY PROGRAM
 A2                            LAKE PLYMOUTH DAM
 A3                          100 YEAR STORM ROUTING
 B     300        0       15                              0       0       4
 B1      5
 J       1        1       1
 J1      1
 K       0     LAKE                      0       0       1
 K1        INFLOW HYDROGRAPH TO LAKE PLYMOUTH DAM
 M       0        2     1.2               1.2       0                       1
 O      98
 O1  0.019    0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
 O1  0.019    0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
 O1  0.019    0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
 O1  0.019    0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
 O1  0.019    0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.038   0.038
 O1  0.038    0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038
 O1  0.083    0.083   0.083   0.083   0.163   0.163   0.163   0.163   0.750   0.750
 O1  0.750    0.750   0.163   0.163   0.163   0.163   0.083   0.083   0.083   0.083
 O1  0.083    0.083   0.083   0.083   0.038   0.038   0.038   0.038   0.038   0.038
 O1  0.038    0.038   0.038   0.038   0.038   0.038
 T                                                       1.5    0.15
 W2             0.54
 X    -1.0    -0.05     2.0
 K       1       DAM                                     1
 K1        ROUTE DISCHARGE THROUGH DAM
 Y                                       1       1
 Y1      1                                                -998.0      -1
 Y4  998.0    998.8  1000.2  1000.7  1001.3  1002.0  1003.0
 Y5      0     36.4   393.9   845.6  1108.5  1745.2  2814.6
 $A      0     14.7    87.7   110.7   149.7
 $E  985.3    998.0  1000.0  1020.0  1040.0
 $E  998.0
 $B1000.7      2.7     1.5     445
 $B  150.0        1   987.0     1.0   998.0  1000.7
 K       1        1                                       1
 K1        CHANNEL ROUTING REACH 1
 Y                                       1       1
 Y1      1
 Y6  0.050    0.035   0.050   979.6   984.6     200  0.0285
 Y7      0    984.6      80   982.6     160   980.6     161   979.6     169   979.6
 Y7    173    982.6     213   983.6     253   984.6
 K       1        2                                       1
 K1        CHANNEL ROUTING REACH 2
 Y                                       1       1
 Y1      1
 Y6  0.050    0.035   0.050   955.2   962.2     850  0.0287
 Y7      0    962.2      80   960.2     160   958.2     163   955.2     171   955.2
 Y7    174    962.2     254   960.2     334   962.2
 K      99
 Q
```

HYDROGRAPH ROUTING

ROUTE DISCHARGE THROUGH DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

RLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-998.	-1

STAGE	998.00	998.80	1000.20	1000.70	1001.30	1002.00	1003.00
FLOW	0.00	36.40	393.90	645.60	1108.50	1745.20	2814.60
SURFACE AREA=	0.	15.	88.	111.	150.		
CAPACITY=	0.	62.	134.	2134.	4728.		
ELEVATION=	985.	998.	1000.	1020.	1040.		

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
998.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1000.7	2.7	1.5	445.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
150.	1.00	987.00	1.00	998.00	1000.70

BEGIN DAM FAILURE AT 18.75 HOURS

PEAK OUTFLOW IS 6593. AT TIME 19.29 HOURS

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1
				1.00
HYDROGRAPH AT	LAKE	1.20	1	1851.
		(3.11)		(52.42)(
ROUTED TO	DAM	1.20	1	6404.
		(3.11)		(181.33)(
ROUTED TO	1	1.20	1	6386.
		(3.11)		(180.83)(
ROUTED TO	2	1.20	1	6211.
		(3.11)		(175.88)(

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	998.00	998.00	1000.70
STORAGE	62.	62.	216.
OUTFLOW	0.	0.	646.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1000.72	.02	218.	6593.	.35	19.29	18.75

PLAN 1 STATION 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6386.	985.6	19.25

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6211.	962.0	19.25

APPENDIX 5

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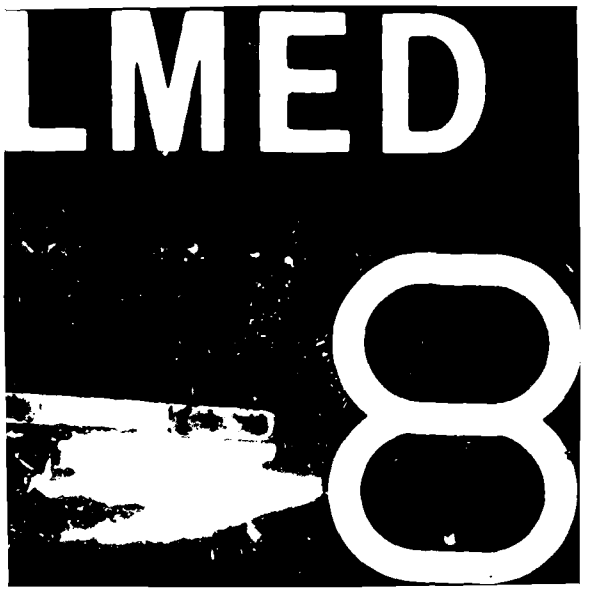
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